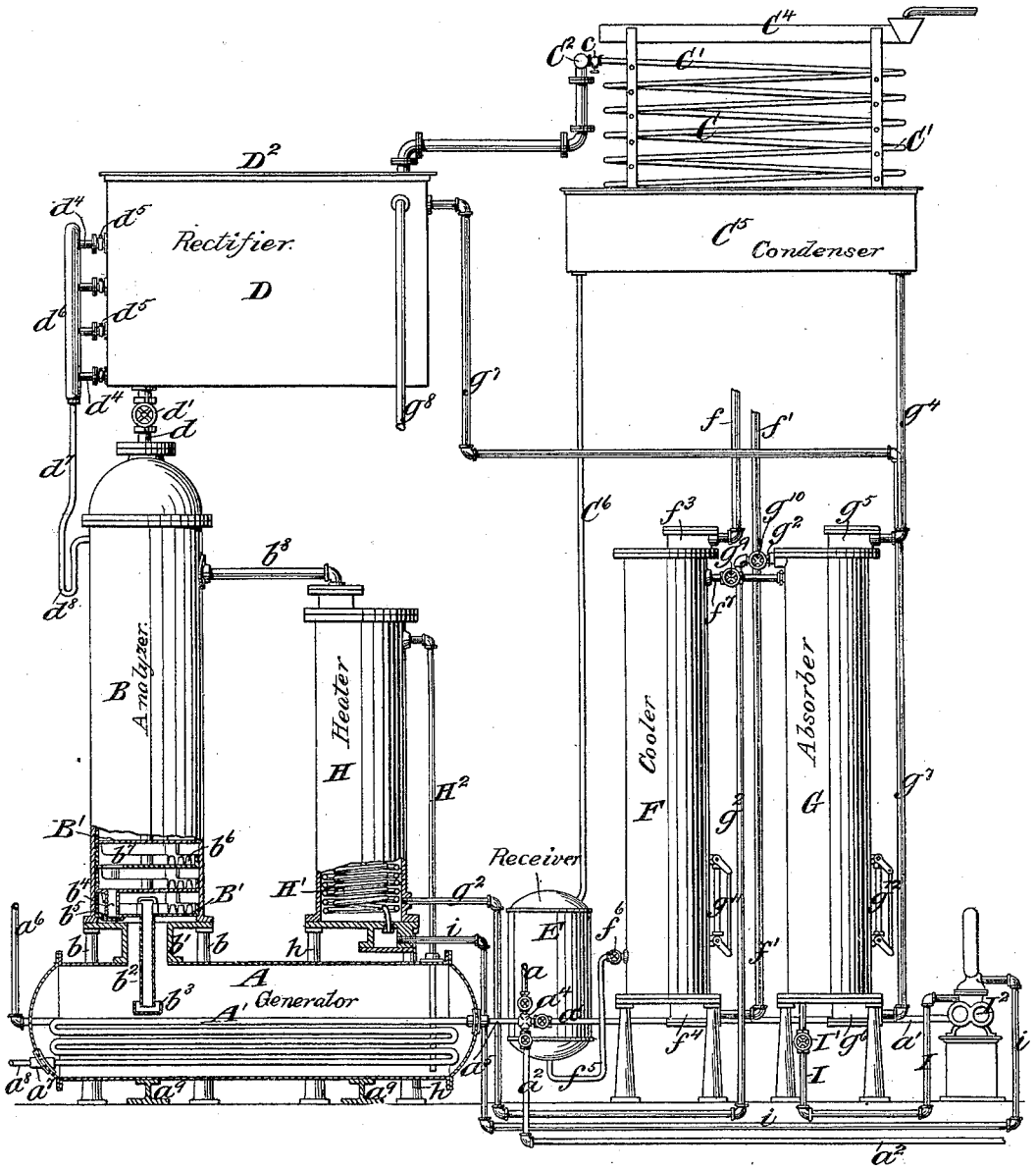
(No Model.) 5 Sheets—Sheet 1.

H. J. W. S. COOKE.

COOLING AND REFRIGERATING APPARATUS.

No. 423,133. Patented Mar. 11, 1890.

Fig. 1.



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(No Model.) 5 Sheets—Sheet 2.

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COOLING AND REFRIGERATING APPARATUS.

No. 423,133. Patented Mar. 11, 1890.

Fig. 2.

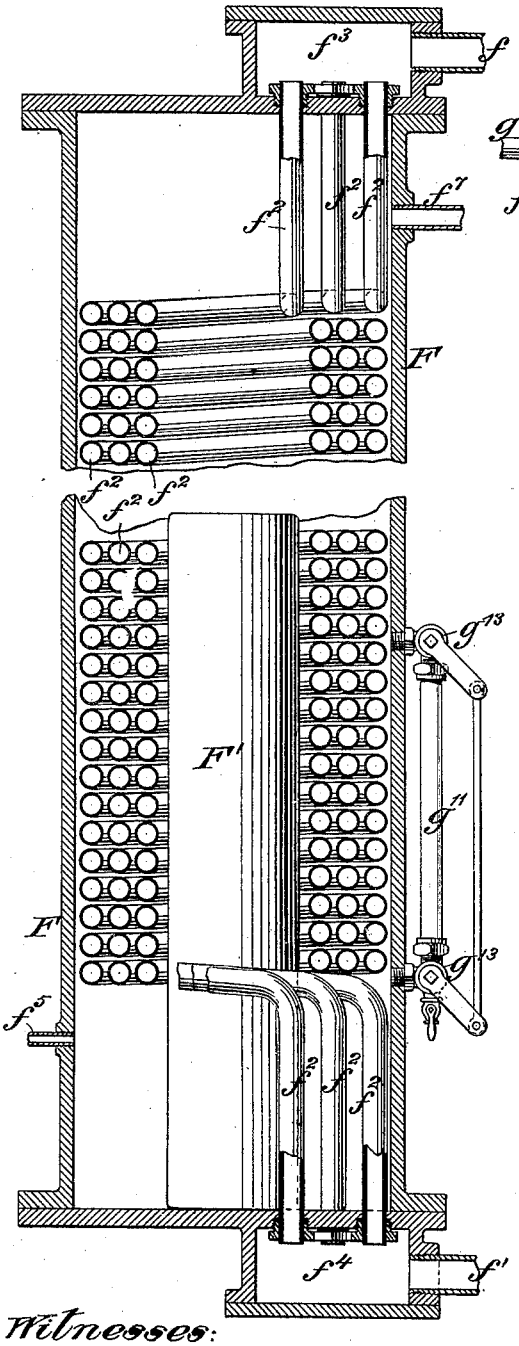
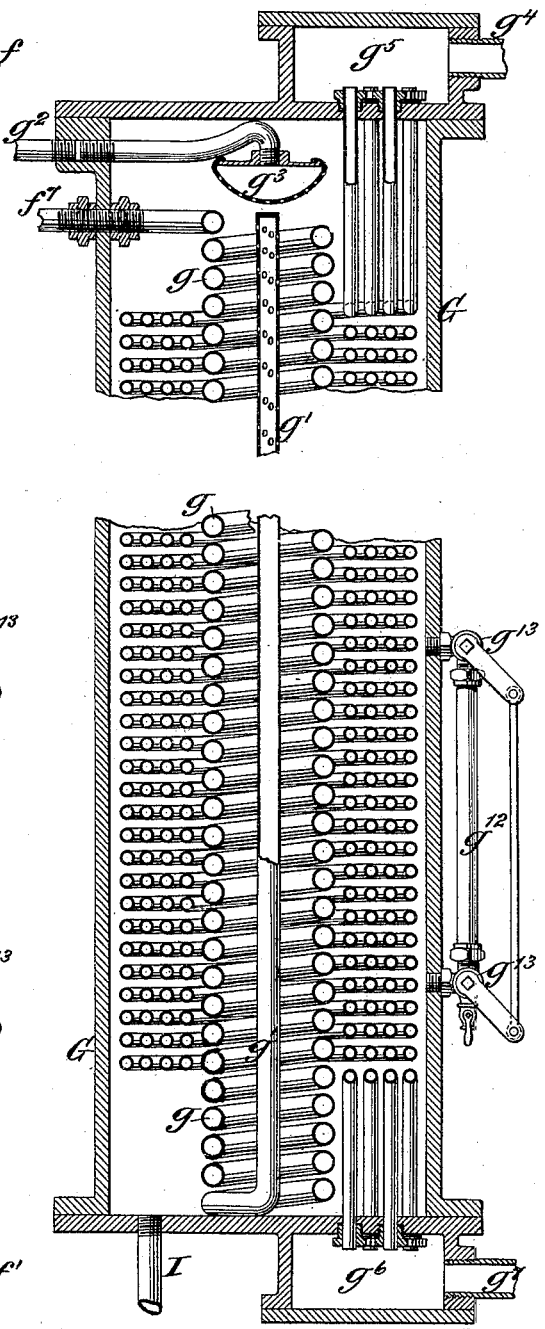


Fig. 3.



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COOLING AND REFRIGERATING APPARATUS.

No. 423,133. Patented Mar. 11, 1890.

Fig. 4.

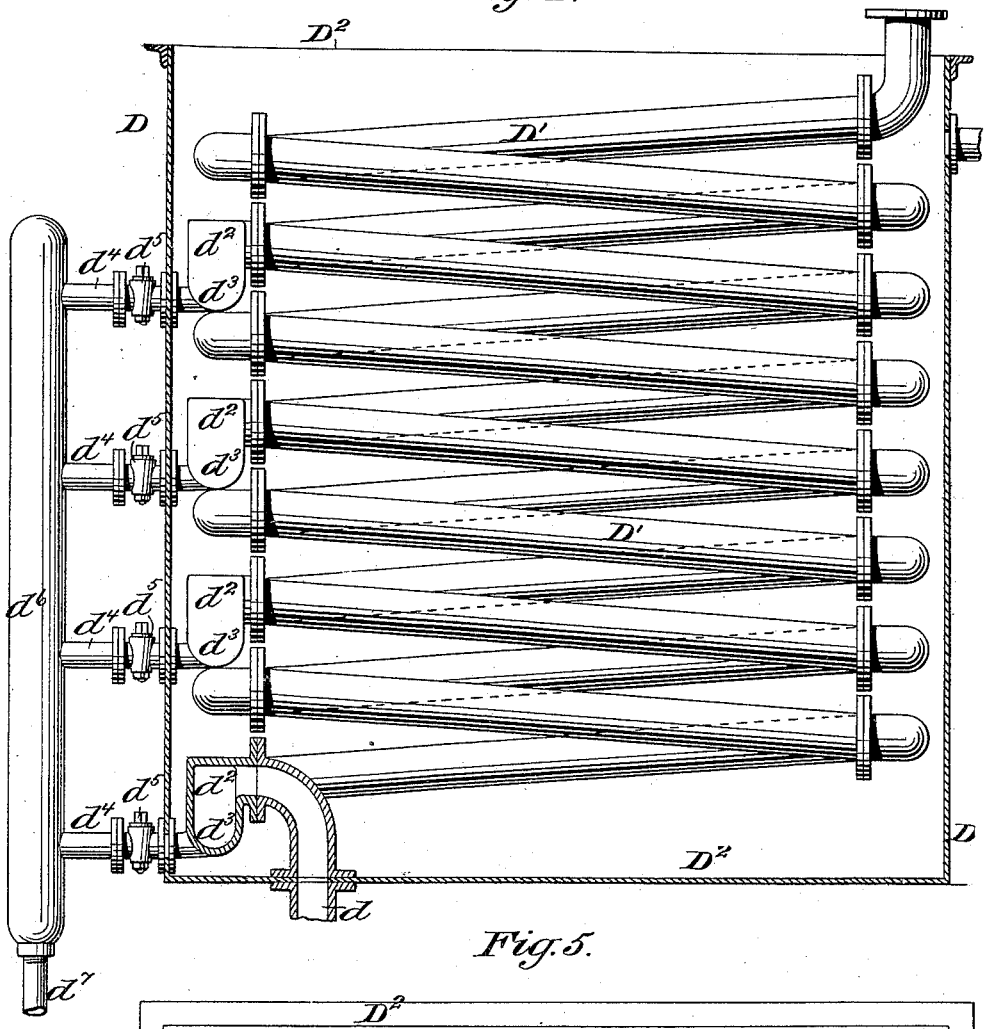
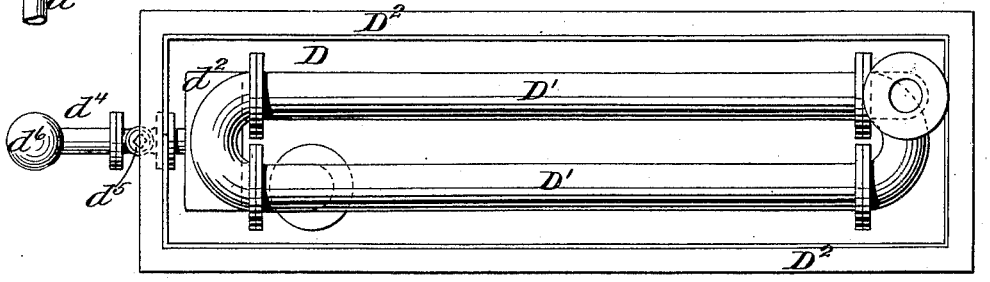


Fig. 5.



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COOLING AND REFRIGERATING APPARATUS.

No. 423,133. Patented Mar. 11, 1890.

Fig. 6.

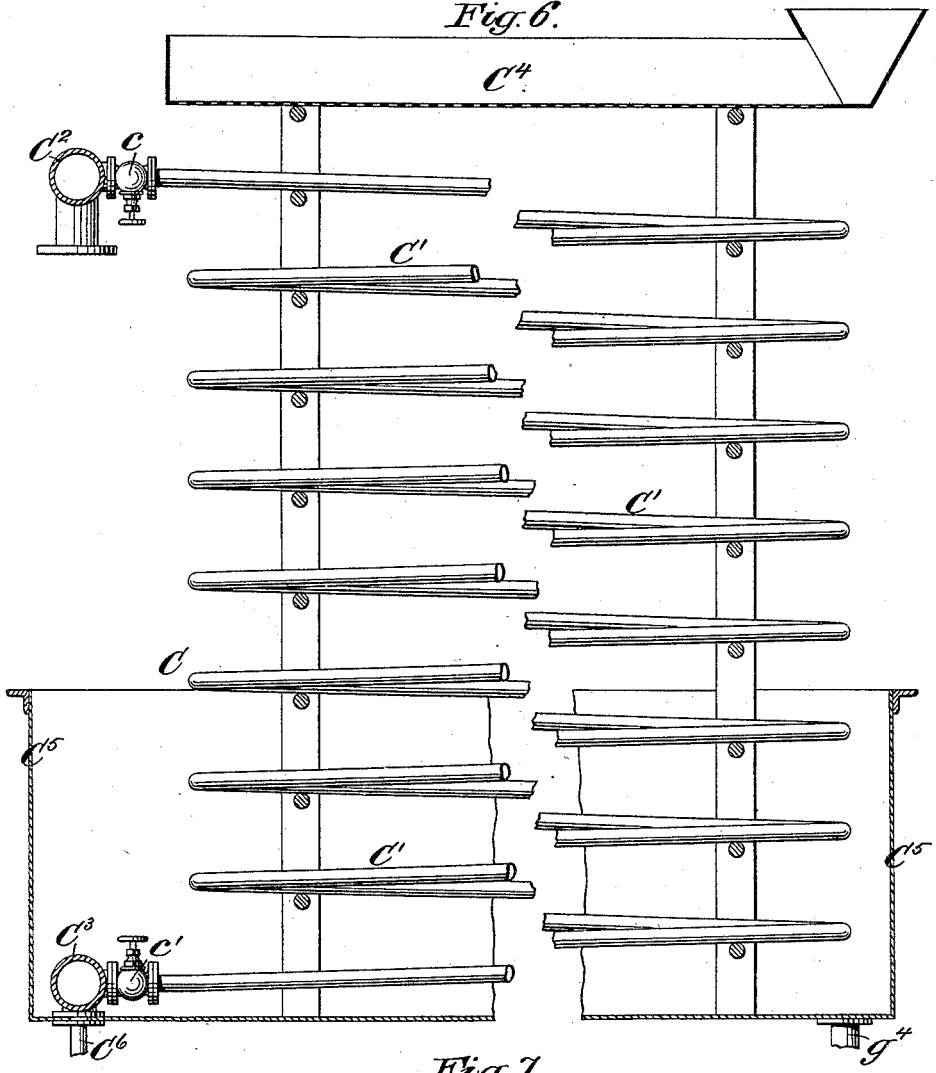
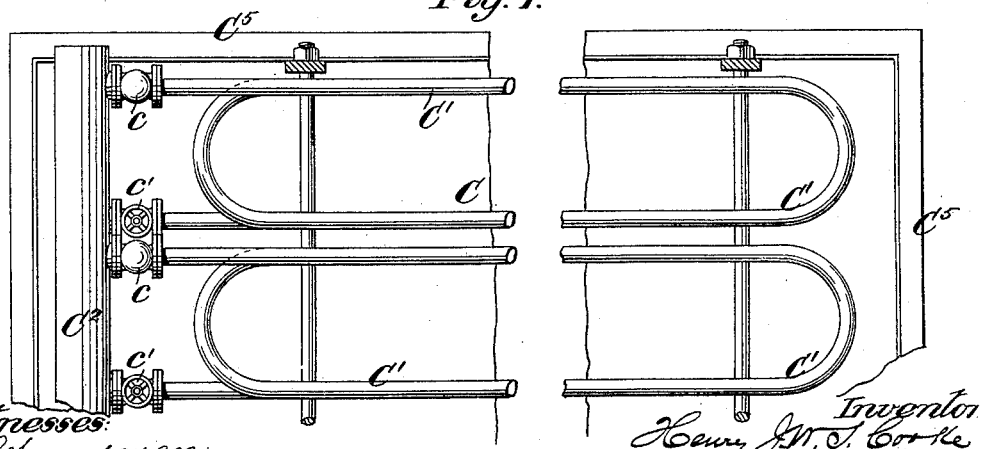


Fig. 7.



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COOLING AND REFRIGERATING APPARATUS.

No. 423,133. Patented Mar. 11, 1890.

Fig. 8

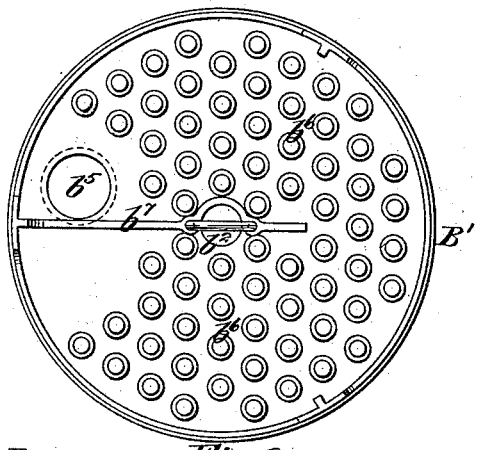

Fig. 9.

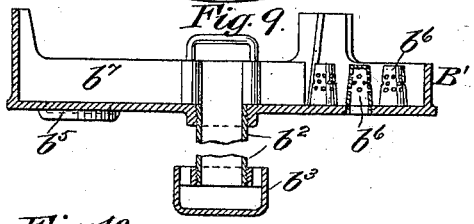

Fig. 10.

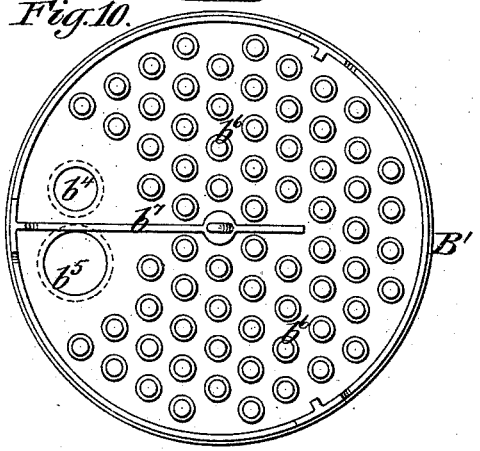

Fig. 11.

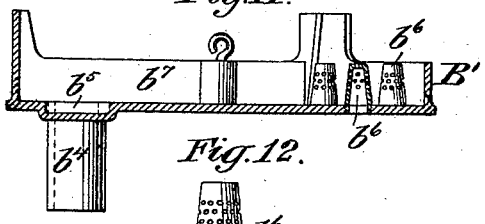

Fig. 12.

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UNITED STATES PATENT OFFICE.

HENRY J. W. S. COOKE, OF EAST ORANGE, NEW JERSEY.

COOLING AND REFRIGERATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 423,133, dated March 11, 1890.

Application filed May 13, 1889. Serial No. 310,561. (No model.)

To all whom it may concern:

Be it known that I, HENRY J. W. S. COOKE, of East Orange, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Cooling and Refrigerating Apparatus, of which the following is a specification.

My invention is an improvement upon apparatus for cooling and refrigerating, for which United States Letters Patent No. 240,049 were issued to Harry F. Stanley, April 12, 1881, and relates to that class of such apparatus in which the cooling results from the expansion of the gas of liquefied ammonia, and in which a supply of liquefying ammonia is consequently maintained by the recondensation of the ammoniacal vapor or gas.

In carrying out my improvement I employ a generator in which ammoniacal liquors are received and in which they are subjected to the action of heat. The vapors arising from the generator pass through an analyzer containing strong ammoniacal liquor, and the gas from the analyzer is conveyed away to a rectifier. From the rectifier the anhydrous gas passes to a condenser, where it is condensed. The liquid ammonia then passes to a receiver, where it is stored, and from the receiver to a cooler, through which the brine or other liquid to be cooled passes. From the cooler the gas passes to an absorber, where it is united with weak ammoniacal liquor from a heater receiving its supply from the generator. The strong ammoniacal liquor thus formed is returned by means of a pump to the heater, where it is reheated and passes to the analyzer to be again converted into gas.

The improvement comprises certain details of construction and arrangement, hereinafter to be more specifically set forth.

In the accompanying drawings, Figure 1 is an elevation of apparatus embodying my improvement, certain parts being broken away and certain parts being in section. Fig. 2 is a vertical section of the cooler. Fig. 3 is a vertical section of the absorber. Fig. 4 is a vertical section of the rectifier. Fig. 5 is a plan or top view of the latter. Fig. 6 is a vertical section of the condenser. Fig. 7 is a plan or top view of the same. Fig. 8 is a detail plan of a certain tray employed in the analyzer. Fig. 9 is a vertical section of the same. Fig. 10 is a plan view of a certain other plate employed in the analyzer. Fig. 11 is a vertical section of the same. Fig. 12 is a detail view of certain nipples employed in conjunction with the trays shown in Figs. 8 and 10. Figs. 2, 3, 6, and 7 show certain portions broken away to save space. Figs. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 are drawn in a larger scale than Fig. 1, and the nipple shown in Fig. 12 is drawn in a larger scale than those shown in Figs. 8, 9, 10, and 11.

Similar letters of reference designate corresponding parts in all the figures.

A designates a generator or still, in which the aqueous solution of ammonia is first submitted to the action of heat. The heat is furnished by steam passing through coils of pipe arranged within the generator A and at the lower portion thereof. I have shown but one of such coils; but I employ two. A coil A′ receives the exhaust-steam, which exhaust-steam is delivered to it from any convenient source. I have shown a pipe a leading from a brine-pump. Another pipe a' leads from an ammonia-pump, and another pipe a^2 may lead from a cold-water pump. The brine-pump and cold-water pump are not shown. These pipes or any others of similar nature may unite at a coupling a^4, and the combined exhaust-steam will be from thence delivered from a pipe a^5 into the coil A′. Into the other of said coils, which is not shown, live steam may be delivered through a pipe a^6 directly from a boiler. Each of the coils is provided with an outlet, which unite at a^7 and discharge through a common pipe a^8, from whence it may be returned to the boiler by means of an ordinary trap. By this method of heating the generator I utilize all the heat in the steam wherever the latter is employed throughout the operation of the apparatus, thereby affecting a material saving in the consumption of fuel. I prefer that the generator shall be made of wrought steel or iron, so that it may be as light as possible. It is supported upon saddles a^9.

B designates an analyzer, in which the liquors to the action of vapors ascending operation of subjecting strong ammoniacal from the generator is performed, and where-

by the gas from the ammoniacal liquor is taken up. The analyzer is cylindrical and is mounted, as shown, upon supports b, so that it will extend upwardly above the generator A. At its lower end it is in open communication with the generator A through a pipe or passage b'. Through this pipe or passage the vapors from the generator ascend into the analyzer. Within the analyzer are arranged a series of trays one above the other, which trays have upon them ammoniacal liquors, from which it is desired to separate the ammonia-gas. The lower of these trays, or B′, is shown more clearly in Figs. 8 and 9. Said tray is provided about centrally with an opening, with which is connected a tube or pipe b^2, which extends downwardly into the generator A, and is provided at its lower end with a cup b^3, forming a water seal. The other trays in the series are illustrated more clearly in Figs. 10 and 11. Each of these trays comprises an outlet-pipe b^4 and a depressed or recessed portion b^5. The ends of the pipes b^4, when the trays are all in place, extend downwardly into the depressed or recessed portions b^5 of the trays next below them, thus forming water seals. All of the trays are provided with upwardly-extending nipples b^6. These nipples, one of which is shown on an enlarged scale in Fig. 12, are screwed at their lower ends into suitable openings in the bottoms of the trays. Their upper ends are closed; but they are circumferentially perforated with a number of small perforations. Extending diametrically across the trays are partitions b^7, which stop short of one side of the trays.

Strong ammoniacal liquor is admitted to the analyzer from a heater H, to be presently described, and passes through a pipe b^8 into the upper portion of the analyzer and onto the upper of the series of trays B′. It passes thence downwardly from one of the trays to another through the several pipes b^4, being compelled in its downward course to circulate over the entire surface of each of the trays, for the reason that it enters upon one side of the partitions b^7, and must pass around them in order to reach the outlet-pipe b^4. The vapor rising from the generator A passes upwardly through the nipples b^6 on the trays successively until it reaches the upper portion of the analyzer. The perforations in the nipples are considerably above the level of the liquor contained in the trays, so that the liquid will not absorb the ammoniacal gases gathered by the vapor in its upward course. By perforating the nipples, also, a complete separation of the gas in small jets as it ascends from tray to tray is effected, and there is a rapid and complete separation of the gas from the water-vapor and condensation of the water-vapor on the trays. During its upward passage the moisture contained in the ascending vapor is to a very large extent condensed and returns with the weaker ammoniacal liquors to the generator. When the ammoniacal gas reaches the upper portion of the analyzer, it is very nearly anhydrous.

In order to render the gas thoroughly anhydrous, I next pass it through a rectifier D, the interior of which is shown more clearly in Figs. 4 and 5. It enters the rectifier from the analyzer through a pipe d, provided with a cock d', and passes into a coil of pipe D′, arranged in a tank D^2, which tank is kept filled with water, and is arranged directly above the analyzer. The coil D′ is composed of straight lengths of pipe extending upwardly at inclines and united together at their ends by return bends. The gas from the analyzer enters at the lower end of the coil and passes out at the upper end thereof. Certain of the return bends, or d^2, upon one side of the coil are so constructed as to have pockets d^3 formed in them, into which waters of condensation flowing down the coil will pass. From these pipes discharge-pipes d^4, provided with stop-cocks d^5, extend. The pipes d^4 connect at their outer ends with a receiver d^6, from which a pipe d^7, in which is formed a trap d^8, extends to the upper portion of the analyzer. The waters of condensation from the coil D′ will thus be conveyed back to the analyzer. By providing each of the pipes d^4 with a stop-cock the reflow of the waters of condensation through any one of said pipes to the receiver d^6 may be controlled. The anhydrous gas now passes from the rectifier to a condenser C, where it is liquefied. This condenser is shown more clearly in Figs. 6 and 7. The condenser comprises in the present example a number of coils of pipe C′, which coils extend downwardly at an incline and are wholly exposed. The anhydrous gas from the rectifier is first received into a manifold C^2. The upper ends of the coils C′ communicate with the manifold C^2. They are provided near their point of connection with the manifold with cocks c. The gas circulates down through the coils of pipe until condensed and the liquefied ammonia is ultimately received in a manifold C^3, located at the lower end of the coils. Adjacent to the manifold C^3 cocks c' are arranged in the pipes. The condensation of the gas is effected by means of water distributed over the condenser-coils from a distributer comprising troughs C^4, which are perforated upon their under sides, so that the condensing-water will pass over and around the pipes in a thin film. This is advantageous, because thereby the full benefit of all the water used is obtained and the liquefaction of the gas under a lower pressure than is usual is possible. The water from the trough C^4, after having done its work upon the condenser, is received in a tank C^5, into which the lower end of the condenser extends.

Connected to the manifold C^3 is a pipe C^6. The liquefied ammonia passes downwardly through the pipe C^6 and into a receiver E, which receiver may be merely a metal shell

of suitable strength and of ordinary construction. In the receiver the liquefied ammonia is stored, to be used as desired.

F designates a cooler, through which brine or other liquid to be cooled is passed, being received through a pipe f from a pump or other source, (not shown,) and discharged through a pipe f' to any suitable receptacle. The internal construction of the cooler is more clearly shown in Fig. 2. It comprises a series of coils of pipe f^2, arranged one inward of the other and through which the liquid to be cooled flows. The upper ends of the coils communicate with a chamber f^3, with which the pipe f communicates, and their lower ends communicate with a chamber f^4, with which the pipe f' communicates. The liquefied ammonia is delivered to the cooler through a pipe f^5, provided with a stop-cock f^6, and communicating with the cooler near the lower end of the latter. It then passes upwardly about the coils of pipe f^2, effecting its work of cooling, and the ammonia-gas is ultimately discharged through a pipe f^7 into an absorber G.

I have shown a plug F′ arranged in the cavity formed by the inner of the coils of pipe f^2. This plug, which may be of iron, wood, or other suitable material, reduces the area of the interior of the cooler, so that a less quantity of ammonia is required to be in the cooler at a given time than would be the case if such plug were not used. The shell of the cooler is cylindrical and made of metal.

In the absorber G the process of causing the ammonia-gas to be reabsorbed by water preparatory to its being conveyed to the heater H is carried on. The gas from the pipe f^7 enters and circulates through a coil g, which extends downwardly and centrally through the absorber to the lower end thereof. The end of the coil is then extended upwardly in the form of a stand-pipe g' through the coil g. The upper portion of the stand-pipe g' is perforated, so that the gas will be delivered therefrom in fine jets. Weak-heated ammoniacal liquors are delivered from the heater H through a pipe g^2 into the absorber G. The end of the pipe g^2 within the absorber is furnished with a rose or button spray-head g^3, located directly above the coil g and stand-pipe g'. The liquor is thus delivered in a fine spray downwardly through the central space inclosed by the coil g, and, meeting the fine jets of gas coming from the perforated upper portion of the stand-pipe g', readily absorb all the gas, so that the liquor when it reaches the bottom of the absorber is strong with ammonia.

I cause the water from the condenser-tank C^5 to flow through the absorber. The water passes from the condenser-tank through a pipe g^4 into a chamber g^5 at the upper end of the absorber, and thence downwardly through a series of coils of pipes arranged one inward of the other and all outside the coil g. I have shown four such coils of pipe, and they open at their lower ends into a chamber g^6, from which a pipe g^7 conveys the water, which has now become heated, to the rectifier D. The water having done its work in the rectifier D is conveyed away through a waste-pipe g^8. In the pipes f^7 g^2 are stop-cocks g^9 g^{10}. By allowing the condensing-water for the rectifier to flow to the same from the absorber, and after it has done the cooling work in the latter, instead of causing it to flow from the rectifier to the absorber, as heretofore, I prevent the possibility of any ammonia-gas being liquefied at the rectifier, as the water, after leaving the absorber, is of a sufficiently high temperature to prevent this. Of course if the water were too cold and liquefaction of the gas should occur at the rectifier, the liquefied ammonia would be returned to the analyzer without having done any work, thus resulting in waste of heat.

Both the cooler E and the absorber G are provided with gage-glasses g^{11} g^{12}, the passages to which may be opened and closed by cocks g^{13} to ascertain the height of the liquefied ammonia or the ammoniacal liquors. Similar gage-glasses may be placed on the receiver and generator.

The strong ammoniacal liquors are conveyed through a pipe I, provided with a stop-cock I′, to an ammonia-pump I^2 of any suitable construction. From the pump I^2 the liquors are conveyed by a pipe i to the heater H. In the heater H are arranged one or more coils of pipe H′, through which the ammoniacal liquors circulate upwardly and from which they are discharged through the pipe b^8 onto the upper of the trays B′, as previously described. The ammoniacal liquors in the coils H′ are heated by means of hot or weak ammoniacal liquor taken from near the bottom of the generator A, and which pass upwardly through a pipe H^2 to the upper portion of the heater H, and is there distributed over and around the coils H′. After having done its work in the heater the weak, but still warm, liquor passes out through the pipe g^2 to the absorber, as previously described. The shell of the heater is cylindrical and made of metal, and I have shown it as supported directly over the generator A upon supports h.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In an apparatus for cooling, the combination, with a generator in which ammoniacal liquor is heated, of steam-coils in said generator for heating said liquor, an analyzer arranged above said generator and in communication therewith, a rectifier arranged above said analyzer and in direct communication therewith, a communication between said rectifier and the analyzer by which waters of condensation from the rectifier are returned to the analyzer, a condenser separate from the rectifier and to which ammonia-gas from the rectifier passes and in which the gas is liquefied, a receiver into which the liquefied ammonia from the condenser is received, a cooler to which the liquefied ammonia from the re-

ceiver passes to cool the brine or other liquid passing through the cooler, an absorber into which the gas from the cooler is received, a heater into which ammoniacal liquor from the generator is delivered, a communication between the heater and the absorber by which the ammoniacal liquor from the heater is delivered to the absorber, a pump receiving ammoniacal liquor from the absorber and delivering the same to the heater, a communication between the heater and the analyzer, a pipe for conveying water from the condenser to the absorber, and a pipe for conveying the same water from the absorber to the rectifier, substantially as specified.

2. In an apparatus for cocling, the combination of an analyzer, a series of trays arranged in said analyzer, each of said trays being provided with a number of upwardly-extending nipples secured in suitable openings therein and provided circumferentially with perforations arranged at a distance above their lower ends, substantially as specified.

3. In an apparatus for cooling, the combination of an absorber comprising a vertically-extending cylindrical shell, a coil of pipe arranged centrally in said shell and through which liquefied ammonia will circulate, a stand-pipe communicating with said coil and extending upwardly through the same, said pipe being provided with perforations near its upper end and with a closed upper end, a perforated distributer for ammoniacal liquors located above said stand-pipe and said coil, and circulating-pipes for water arranged in said shell and surrounding the said coil, substantially as specified.

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